

T H E S I S
PRESENTED for the DEGREE of DOCTOR of MEDICINE,
UNIVERSITY of EDINBURGH,
BY
EUSTACE RUSSELL, M.B., Ch.B., (EDINBURGH, 1906)

PULMONARY and PLEURAL SUPPURATION.
A REVIEW of ~~a~~ SERIES of POST MORTEM REPORTS
With Notes On The
DIAGNOSIS and TREATMENT.



September, 1929.

I N T R O D U C T I O N .

As the result of an enquiry into Pulmonary and Pleural Suppuration, undertaken as a Post-Graduate study during the past few months, this Thesis consists of two parts, namely:-

I. PULMONARY SUPPURATION

II. PLEURAL SUPPURATION.

I. Pulmonary Suppuration is further sub-divided into two headings according to the anatomical situation in which the suppuration arises, thus:-

(i) Suppuration in the Alveoli.

(ii) Suppuration in the Bronchi.

These anatomical varieties of Pulmonary Suppuration are further dealt with in sub-divisions::

1. (a) Lobar pneumonia with Abscess.
(b) Embolic Lung Abscess
(c) Non-embolic Lung Abscess
2. (a) Acute Purulent Bronchitis.
(b) Acute Bronchiectasis.
(c) Chronic Bronchiectasis.
(d) Emphysematous Bronchiectasis.

II. Pleural Suppuration is conveniently discussed as a sequel to other conditions and these are grouped as follows:-

- a. Following Broncho-pneumonia
- b. Following Lobar-pneumonia
- c. Extension of Suppuration from the abdominal cavity.
- d. Systematic pyaemia
- e. Other causes.

A further sub-division is made as under:-

1. Post Mortem Findings.
2. Aetiological Factors.
3. Diagnosis and Treatment.

The first two of these are from the survey of a series of Post Mortem Records with additions from the literature, in some cases, for the sake of completeness of the record, for example actinomycosis of the lung is mentioned, but was not in the series.

These Records were taken from the Post Mortem and Surgical Departments of the London Hospital.

In regard to Diagnosis and Treatment, the opinions expressed are partly the opinions of the author after considerable experience in practice, and partly the impressions gained from attendance at Post Graduate Lectures and Clinical work at Victoria Park Hospital, the London Hospital and elsewhere.

PULMONARY AND PLEURAL SUPPURATION.

A REVIEW of a SERIES of POST MORTEM REPORTS WITH NOTES ON THE DIAGNOSIS AND TREATMENT.

FOREWORD.

In dealing with the subject of Pulmonary and Pleural Suppuration, it has to be recognised that in recent years the diagnosis and treatment of these conditions have made a very considerable advance, and that where they used to be regarded as purely of Medical interest they now come very often into the domain of the surgeon, and indeed it is the co-operation of the two that lends the most hopeful solution of the difficulty faced in the treatment of these cases.

Primarily all these conditions to be described are Medical and those which develop in the course of another illness and are incurable, remain medical that is, those cases which are terminal diseases, but those in which it is recognised that active interference holds out the best prospect of recovery come naturally into the domain of the surgeon.

Surgical science in the treatment of intrathoracic conditions has made a very real and valuable/

valuable advance in the last few years, and it is more than likely that with improved methods of diagnosis, improved technique and better methods of anaesthesia, more conditions will be amenable to surgical interference and will show a very much reduced operative risk.

It is proposed for the purposes of this thesis to review the various considerations in regard to the subjects mentioned as the basis of the work, to give attention to the causation, pathology, symptoms and treatment of the various conditions.

It is, therefore, necessary to give a fairly comprehensive account of the observed symptoms and signs, the diagnosis and treatment, with an account of the post mortem changes found in those cases with a fatal termination.

The treatment of the subject can be conveniently divided into several headings, according to the site affected in the organs named, and to classify the conditions found in clinical examination and the investigation of the post mortem state, so that the two sets of facts may bear some relation to each other. Anatomically it is convenient to regard the lungs as consisting of three main parts.

- (1) The Air Alveoli
- (2) The Bronchial Tubes
- (3) The Blood Vessels.

Any one of these component parts or all of them may become infected, and this infection may be acute or chronic. The condition may tend to become localised and eventually give rise to an abscess.

It is as well for purposes of consideration of the various forms of suppuration, to devise some classification for the better presentation of the conditions which ensue from the infection of these various component parts and this is done as follows:-

- (1) Lobar Pneumonia with abscess
- (2) Embolic Lung Abscess
- (3) Non-embolic Lung Abscess.

It is obvious from the above that one of these conditions, that is embolic lung abscess, strictly speaking, begins in the blood vessels, but so rapidly does it spread to the alveoli that it is considered as arising there.

Suppuration in the bronchial tubes may be divided similarly into four main groups, and they are:-

- (1) Acute Purulent Bronchitis
- (2) Acute Bronchiectasis
- (3) Chronic Bronchiectasis
- (4) Emphysematous Bronchiectasis.

These groups are understood to cover the conditions affecting/

affecting the small bronchi or bronchioles, as well as the large bronchi.

ALVEOLAR SUPPURATION.

I. LOBAR PNEUMONIA with ABSCESS.

PATHOLOGY AND AETIOLOGY.

If an examination of Post Mortem Records is made, one is struck with the fact that this is a condition not commonly found, and indeed, that it is relatively rare, and this would appear at first sight to suggest that suppuration during the course of a Lobar Pneumonia is not often met with whereas it is well known that it is not infrequent. The reason of this discrepancy is not far to seek clinically, as quite often the abscess contents are evacuated through the bronchi and the condition cures itself. This probably accounts, too, for the fatal cases of pneumonia in which there is a very high leucocyte count.

In a series of cases examined, about 7% of cases were found at autopsy, that is to say that only 7% of cases of pneumonia which were examined post mortem, showed signs of abscess formation. In these cases there are other considerations which influence or appear to influence the onset of the process/

process, e.g. some condition which tends to lower the resistance, and these will be dealt with now. Age, undoubtedly, has its effect in some cases and it may be said that there is a greater likelihood of abscess formation after the age of 50 and old age, especially if associated with alcoholism, causing a still further lowering of the resistance, is important.

Pneumococcal Meningitis is also present in some cases which have been recorded and Pneumococcal pericarditis and Endocarditis co-exist in association with lung abscess, but the series of cases reviewed did not disclose any such.

Several cases of Lobar Pneumonia as a sequela of a major operation have been recorded, terminating in abscess formation, and in one case operation for neoplasm of the lung, abscess of the lung occurred in the already existing consolidation of the lung. Death usually results within 7 or 8 days after the onset of pneumonia and consolidation is found to be in a state of grey hepatisation or resolution in these cases. The appearance of the lung is somewhat similar to that of an uncomplicated case of Lobar Pneumonia and there is an acute fibrinous pleurisy in all cases, but occasionally the abscess has been known to burst into the pleural cavity, giving rise to an Acute Empyema or Pyo-pneumothorax. The Mediastinal/

Mediastinal glands are also affected, with grey infiltration and the bronchial glands are similar.

Macroscopically the abscess differs from other types of lung abscess and the lung is in most cases in a state of grey hepatisation. The abscesses are always multiple, and are found scattered throughout the affected lobe, and are not found particularly near the pleura. The size may be anything from that of a small nut, to a small orange and has no regular margin, but an irregular outline and not easily definable. There is no wall to the cavity, and no pyogenic membrane. The abscesses may coalesce and be intercommunicating, and in all cases there is a purulent infiltration which joins abscess to abscess.

Microscopically the alveoli are filled with neutrophil polymorphonuclear leucocytes, many of them showing fragmentation, degenerating strands of fibrin and gram positive diplococci.

The walls of the alveoli are thin and broken down, the veins contain thrombi and signs of recent haemorrhages are seen in the collection of red blood corpuscles.

The parts of the lung not affected by the abscess formation show the signs usually present in grey hepatisation.

SYMPTOMS/

SYMPTOMS AND DIAGNOSIS.

Usually in cases of Lobar Pneumonia there is in those that recover a crisis in the vast majority of cases, in the remainder there is a lysis, and in a few there is a complication superadded or resolution is impeded. In the condition at present under consideration the retardation of the healing process is due to the suppurative process arising in the lung. There are one or two important features which point to a diagnosis of the condition, and these will be considered now.

I. PREDISPOSING CONDITIONS.

Age has already been mentioned as a predisposing factor, and this merely on account of the enfeebled resistance to any infection, and a tendency to morbidity. Age per se may be the only factor operating, but there is often enough, some other condition associated with it in the retardation of the resolving process. It is a well known and established dictum that Alcoholism is of considerable gravity in the prognosis of a Lobar Pneumonia, and it probably favours the establishment of lung abscess.

Diabetes Mellitus also adds very considerably to the gravity of the prognosis of a Lobar Pneumonia, and again the formation of lung abscess is/

is favoured. The urine in all cases of delayed resolution should be tested for sugar, as of course it should be done as a routine. The possibility of the lung condition in diabetes being due to Pulmonary Tuberculosis is not to be lost sight of but does not enter into discussion here.

As a complication following operation Lobar Pneumonia with abscess has been mentioned especially when the condition found at operation is not removable or alleviated, as in the case of inoperable carcinoma.

II. SYMPTOMS.

The symptoms are those of an intense intoxication with fever and rigors, and sweats are common. There is often severe pain in the chest and dyspnoea. The breath may be offensive and cough is at times a prominent symptom. There is however no particular localising symptom which is helpful in clinching the diagnosis. The symptoms are of comparatively little importance except in so far as they are in no sense characteristic.

III/

III. PHYSICAL SIGNS.

It would be well nigh impossible to make a diagnosis of pulmonary abscess from a consideration of the physical signs.

They are simply as a rule those of the pneumonia. There may be over the site of the original pneumonia a dullness on percussion diminished vocal resonance and fremitus, faintness of the breath sounds, crepitations and the presence of a pleural friction rub.

There is however no sign that is pathognomonic of Lung abscess.

The blood changes are not characteristic. A quite considerable leucocytosis may be present and simply indicates that there is a suppurative process going on in some part of the body.

IV. SPECIAL METHODS.

There is no special method of examination which would help in the making of a diagnosis and the X-Ray examination of the chest does not help.

V. THE SPUTUM.

It is very important to examine the sputum carefully in these cases. As is known in cases of pneumonia/

pneumonia the sputum is usually sticky and mucoid in character and this may in these cases be replaced by a very foul and copious discharge of pus.

This is Nature's way of getting rid of the condition and may result after two or three days or more in a complete relief of the disease. This only occurs when there is one abscess. When there are multiple abscess formations and there is no outlet by the bronchial tubes then the condition persists and becomes fatal.

The sputum has not the peculiar foetor of Bronchiectasis. It lacks the indescribable "sweetness" that is associated with both Bronchiectasis and lung gangrene.

The sputum contains pus cells, pneumococci and strands of elastic tissue.

DIFFERENTIAL DIAGNOSIS.

As has already been indicated the diagnosis of this condition is by no means easy, and it is just as well to indicate that in those cases of Lobar Pneumonia which do not terminate in a reasonable time the possible presence of pulmonary suppuration should be suspected.

There are four conditions to be considered:

(1)/

- (1) Delayed Resolution.
- (2) Empyema.
- (3) Gangrene of the Lung.
- (4) Bronchiectasis

The character of the sputum is probably the best guide in the diagnosis and it may form the only indication that there is lung destruction going on by the presence of elastic fibres in the sputum.

TREATMENT.

The condition may as has already been noted cure itself by the rupture of the contents of the abscess into a bronchus, but in those cases where there are many abscesses the evacuation of the pus through the bronchi is extremely uncommon and the state of the patient correspondingly grave. Those terminating fatally, demonstrated as a rule, that the abscess is remote from the vicinity of the bronchial tubes, and there is no indication during life of the presence of abscesses, and in fact the sputum may be very little in quantity. There is no treatment of a surgical nature indicated in the case of these abscesses and they are to be dealt with by expectant methods only, any active interference being certain to meet with disaster.

II. EMBOLIC ABSCESS.

This group includes those cases which arise in the lungs following transmission of infected material to the lung substance by the blood stream from a distant focus of suppuration. It is, therefore, a manifestation of the presence of a systemic Pyaemia and may exist in rare cases as the only indication of this condition. There are however, other lesions usually to be found in the kidneys, myocardium, brain, spleen, and intestines. When the primary source of the Pyaemia is drained by the radicles of the Portal vein, Liver abscesses result from the formation of a Portal Pyaemia. If this process goes on to a generalised systemic pyaemia one of the first lesions noticed is the formation of embolic or metastatic lung abscesses. If the patient should survive the illness for some days then there is the formation of pyaemic abscesses elsewhere.

In the series of autopsies embolic abscesses were found in 33 instances. Of these 63% were males and 37% females, and the average age was 20. It will thus be seen that embolic lung abscess is a relatively more common disease in young people and this is quite easy of explanation when the nature and origin of the focus is looked into.

In/

In 14 cases the primary cause was found to be osteomyelitis, otitis media or mastoiditis and these are conditions of greater frequency in young subjects. Puerperal Pyaemia is also an important cause of the condition and here again the age of the subject is important.

MACROSCOPICAL APPEARANCES.

The lesion is usually multiple. This is a constant and characteristic feature so that single abscesses should be regarded in the absence of other manifestations of pyaemia to be Non-Embolic. The abscesses are as a rule numerous but they vary in number; they are found rarely in both lungs, the upper lobes are not the sites of deposits. Their situation is usually at the lower and posterior borders of both lower lobes distributed immediately under the pleural membrane. They are not by any means confined to this situation but are scattered in the lung tissue.

The size varies very considerably from a miliary abscess to one of considerable size and the more chronic the illness the larger the abscess - in some a thick pyogenic membrane is found. The shape is usually spherical but occasionally it is pyramidal in/

in form, probably the result of a pyaemic infarct. The infarctions present a yellowish grey purulent centre with a prominent red or haemorrhagic border. A septic thrombus can sometimes be found lodged in the lumen of the artery at the apex of the infarct.

Microscopically the centre of the abscess shows the presence of purulent debris consisting of digested lung tissue and pus together with the organism responsible for the condition. Recent granulation tissue infiltrated by neutrophil polymorphs can be seen forming the edge of the abscess, interspersed amongst this sometimes appears the isolated multinucleated giant cells. The surrounding tissue shows an organising catarrhal pneumonia with evidence of haemorrhage. The organism present in the abscess is similar to the one found in the original focus of suppuration. Commonly it is the *Staphylococcus*. In all cases resulting from Osteomyelitis and from skin infections the *staphylococcus* is present and in some cases of otitis media mastoiditis and puerperal sepsis. The *streptococcus* is found in most of the cases of puerperal pyaemia and it is rare to find a *pneumococcus*. A *streptothrix* has been reported in some cases but they are rare.

COMPLICATIONS/

COMPLICATIONS.

In the immediate neighbourhood there are to be found nodules of consolidation of the lung and around the bronchial tubes there are areas of consolidation. Fibrinous Pleurisy is a constant feature and in the early stages this pleurisy is confined to patches immediately superficial to the sub-pleural abscesses. This condition tends to spread and to involve eventually the whole of the pleural surface. The pleurisy may be sero-purulent in character when there has been a rupture of one or more of the pyaemic abscesses into the pleural cavity. The empyema may be bilateral.

DIAGNOSIS.

This is by no means easy and often it is not made until autopsy. It is probable that the reason for this is, that in cases in which there is a supervening pericarditis or say an attack of Osteomyelitis this is regarded as a terminal event and an indication that a state of systemic pyaemia has resulted. In these cases the lungs are not examined except in a perfunctory manner.

Again/

Again the signs in the lungs may not be easy of detection, and again if the diagnosis of pyaemia has already been made the examination of the patient's respiratory system may well be regarded as of little importance owing to the distress to the patient.

The Physical signs are those of Broncho-pneumonia. If the consolidation is widespread there may be some impairment of the percussion note patchy in distribution.

There may be a pleural rub heard and some crepitations are the rule. If an empyema results there becomes apparent a definite dullness, tactile fremitus is usually absent, breath sounds are diminished and vocal resonance is altered. These local signs appearing in a patient already suffering from focal sepsis of the nature already referred to and accompanied by a rapid pulse pyrexia and some degree of temperature indicate the presence of pyaemia with embolic lung abscess. Additional evidences are the presence of a pericardial rub, the blood showing a leucocytosis and the finding of the organism in the blood by culture. These cases in the puerperal states may be chronic, as already indicated, and the pyaemia then is due to the Streptococcus.

Usually the disease has a rapid course and death/

death ensues in a few days.

TREATMENT.

The disease once established is of the greatest gravity and is invariably fatal. Little can be said regarding treatment which is essentially of a palliative character. In the chronic cases when an empyema supervenes it may become necessary to adopt active surgical treatment, and this can be carried out best by the resection of a rib under local anaesthesia. The ultimate outlook in these cases is the same.

III. NON-EMBOLIC LUNG ABSCESSSES.

These lung abscesses arise as the result of suppuration arising either in the lungs or spreading to the lungs from some adjacent focus of infection. It is not a common condition, and not by any means as common as the embolic variety just described.

Cases of this variety of abscess fall into well defined groups and it would appear that there is a greater liability to the condition in very young children and in those whose years have advanced beyond the fifth decade.

In/

In analysing the aetiological factors in these cases there are:-

I. ABSCESS IN BRONCHO-PNEUMONIA.

This is very much more frequent than in the case of Lobar Pneumonia probably three times as common, and the abscess may be primary or secondary.

- (a) Lung abscess following broncho-pneumonia in childhood.

Those which arise in the course of a broncho-pneumonia and in the absence of a discoverable causal agent may be classed as primary, and these always or almost always occur in children. The condition may be unilateral and usually is, but there may be multiple abscesses present.

- (b) Lung abscesses in Secondary Broncho-pneumonia.

This is a commoner condition than the last and is not seldom due to, or a complication of surgical interference under general anaesthesia. The abscess formation is unilateral despite the fact that the broncho-pneumonia was bilateral and for some reason not determined, it affects the right lung more often than the left.

In various operations for the relief of gastric affections it may occur and is not uncommon as a complication of debilitating conditions such as old/

old age, cachectic malignant disease, tuberculosis and other states.

Actinomycotic lung abscess of a non-embolic nature has been described and in this case there is an area of dense fibrosis and the pneumonia is found to be honeycombed with small abscesses and infiltrated by dried yellow pus in the parts affected. The pus shows the characteristic ray fungus.

In carcinoma of the thyroid gland ulceration of the growth into the trachea has followed and infection starting on the granulating surface of growth spreads to the bronchi and alveoli.

Lung abscess following Inhalation of Corrosive poisons. This has occurred in a case in which a man had taken ammonia with suicidal intent. The patient lived for 17 days and the post mortem examination showed a diffuse pneumonia consolidation with gangrenous walled abscesses.

Lung abscess in Carcinoma of the lung.

This may occur in one of three ways:-

(1) Broncho-pneumonia become established and resolution is prevented by the presence and the continued extension of the malignant growth within the lung, and abscess formation results.

It is rare to find this condition but in most cases of carcinoma of the lung more or less pulmonary/

Pulmonary consolidation is found.

(2) Suppuration is said to occur in the growth itself but it is probably a very rare occurrence.

(3) The close relationship of the growth to a bronchus and the infiltration of the bronchial wall causes an extension of the growth to the *mucosa* of the bronchus. /u

This causes in time an obstruction of the lumen of the tube with a consequent retention of infective material giving rise to bronchiectasis.

II. LUNG ABSCESS ARISING FROM SPREAD OF SEPSIS ARISING IN STRUCTURES OUTSIDE THE LUNG.

This is not nearly so common as ^w occurrence as the former but it is not a very rare occurrence. In these cases there are two main sources of the infection:-

(A) Within the Thoracic Cavity.

(B) In the abdominal cavity.

(A) In those cases there are three sources found.

(a) Secondary to Carcinoma of the Oesophagus.

This is probably the commonest cause of infection in these cases arising within the thorax and in most of the cases the condition is due to the extension of the malignant growth to involve the trachea with resultant/

resultant perforation.

The access of septic material to the trachea causes very quickly the onset of a broncho-pneumonia and later on the formation of an abscess. The abscesses may affect either or both lungs. Occasionally the carcinoma may cause the trouble by extending directly from the oesophagus into the lung itself and in these cases the infection is introduced by the direct spread of the growth rather than by the infection of the bronchial tubes as mentioned above. Lung abscess is a common concomitant of malignant disease of the oesophagus, but as a rule it is due to the general debilitating effect of the growth rather than to a direct effect.

(b) Perforation of the lung by a foreign body lodged in the oesophagus.

This has been known to occur from the swallowing of a jagged bone by a mentally deficient boy. The patient died 18 days after the accident and at autopsy it was found that the bone had perforated the oesophagus and a foul abscess was present in the posterior mediastinum. This extended up to the front of the thyroid gland and also into the substance of the upper lobe of the right lung.

(c)/

(c) Extension from the bony framework of the thorax.

One case is recorded in which suppuration of the periosteum of the 4th Dorsal vertebra tracked its way beyond the angle of the ribs on the right side and extending along the oesophagus burst its way into the stomach. It also had tracked its way into a large abscess cavity in the posterior portion of the lower lobe of the right lung.

(B) The Primary Focus is situated in the abdominal cavity.

In these cases the abscess reaches the lung after traversing the diaphragm and extending to the pleura. This does not mean that on that account there is an extensive empyema formed when the pleura is perforated, on the other hand it is unusual to find that to be the case and the rule is that there has been such extensive formation of adhesions between the visceral and parietal pleura and the upper surface of the diaphragm that the localisation of the abscess is effected and the suppuration extends directly it would seem, from the abdomen into the lung tissue, and moreover the perforation in the diaphragm and the pleural layers is surrounded by dense adhesions.

The/

The aetiology of this type of abscess is properly considered under three separate headings.

(a) Lung abscess following amoebic abscess of the liver.

The extension of tropical abscess of the liver to the lung arises from those abscesses situated in the upper part of the right lobe of the liver, as a rule they exhibit a thick wall and are adherent to the diaphragm. The lung becomes honeycombed with abscess and there may be in these cases no extensive empyema.

(b) Lung abscess from a Suppurating Hydatid cyst of the Liver.

This is a rare condition in Britain but it may occur in cases where a hydatid cyst becomes infected and there is found adhesions between the cyst and the diaphragm with a perforation through the diaphragm and a communication with an abscess in the lower lobe of the right lung.

(c) Lung abscess secondary to subdiaphragmatic abscess.

This is not a very rare complication as a complication of operation on the stomach. It may occur either after an emergency operation for the treatment of perforated ulcer of the stomach or duodenum/

duodenum, or it may occur as the result of sepsis acquired at a laparotomy. The mode of spread and extension in these cases is similar to that obtaining in the cases of suppuration initiated in the liver substance and the description above applies to this.

The macroscopical appearances of the non-embolic lung abscess do not call for recapitulation and the microscopical appearances are very similar to those found in abscess of the lung in Lobar Pneumonia.

The Bacteriology of this type of abscess is necessarily very variable. The infection is as a rule a mixed one and a variety of organisms are present. Staphylococci are present in some cases, Streptococci and Pneumococci in others and Bacillus Coli is superadded when the infection has spread from the abdominal cavity.

In addition to these there may be found in particular cases actinomycoses and in others the scolices hooklets and daughter cysts of the Taenia Echinococcus may be found in the abscess cavity.

COMPLICATIONS of PULMONARY SUPPURATION.

I. BRAIN ABSCESS.

This is a rare complication of Pulmonary Suppuration but it is recorded, and brain abscess seems/

seems to be rarely caused even by Bronchiectasis, yet the latter is regarded definitely as a prime cause in some cases.

II. EMPYEMA.

As a cause of lung abscess Empyema has already been cited and it also may result from the tracking of the abscess to the surface of the lung and rupture into the pleural cavity. It occurs on either side of the chest and may exceptionally occur on both sides.

DIAGNOSIS.

The matter of diagnosis of lung abscess has already been discussed to some extent, and emphasis will be laid now on factors of importance in the diagnosis of the Non-Embolic type of lung abscess. It is not possible to diagnose the small abscesses of Broncho-pneumonia in childhood with any degree of certainty, as the condition is usually masked by the accompanying broncho-pneumonia and again the abscess is not voided in the sputum as in the case of an adult should it find its way into a bronchus. It has already been emphasised as to the importance of observing the sudden onset of the expectoration/

expectoration of large quantities of foul sputum in the course of an illness in which the possible aetiological factors mentioned are concerned.

In cases where the abscess has followed either Amoebic or Tropical abscess of the liver the sputum examination shows the presence of bile and has what is called the "anchovy sauce" appearance.

In the case of Hydatid cyst which suppurating tracks into the lung, scolices, hooklets and daughter cysts are found in the sputum and it is further of interest that the eosinophilia which is a characteristic of hydatid cyst disappears with the onset of suppuration and a polymorphonuclear leucytosis results. The presence of the *Bacillus Coli* in the sputum of a patient known to be suffering from intra-abdominal sepsis and showing physical signs in the lung, gives a strong clue to the possibility of a lung abscess supervening upon the spread of the abdominal suppuration through the diaphragm.

Radiological examination of the chest is not as a rule of much value as the appearance of an abscess as a localised shadow is very rare, and the outline is generally obscured by the co-existing broncho-pneumonia. Lipiodal injections are not very helpful in these cases.

TREATMENT/

TREATMENT.

It is quite obvious that in a great many instances the treatment of lung abscess can only be palliative as no active operative measures can be directed to the relief of the lesion primarily responsible for the abscess. The abscesses which follow the carcinomatous conditions mentioned, those of the oesophagus lung and thyroid gland will fall into this category, and so will those consequent upon a broncho-pneumonia in debilitating states.

The treatment of those cases of small abscesses in childhood does not assume any special character and it is merely necessary to emphasise the value of good nursing and very special care. No active measures other than these are to be recommended unless it can be established with certainty that a fairly large abscess has formed. For those cases in which definite steps can be taken for their relief and a set course can be thought of the following two phases may be recommended:-

- (I) Expectant or Medical Treatment.
- (II) Active or Surgical Treatment.

~~ACTIVE/~~

II. EXPECTANT OR MEDICAL TREATMENT.

All cases must pass through this phase. It is unwise to undertake surgical treatment too early in lung abscess and unless the matter becomes a surgical emergency which is seldom, it is better to weigh all the aspects of the case before any energetic treatment is adopted. When the general condition of the patient remains good, when the expectoration of foul sputum continues and the exact localisation of the abscess remains difficult the treatment must always be of a passive nature. Consequently it may happen that a small abscess will make its way out and the condition cures itself.

A very careful watch must be kept on the patient's local and general condition, and the minimum respiratory effort made by the patient. It is thus wise to have the patient in the semi-sitting position well supported, and of very great importance is the provision of sufficient sleep. For this purpose it may be necessary to have recourse to narcotics, but they should be withheld unless the loss of sleep militates against the mental and physical well-being of the patient.

The heart should be carefully watched and should/

should be stimulated if necessary, not waiting for the signs of cardiac failure which would be too late. Creosote is useful given by the mouth and stimulating expectorants give the patient some comfort.

When in the course of this treatment there is no improvement in the patient's condition then it may be necessary to take more active measures and the following may be looked upon as indicating when these more active measures should be undertaken.

- i. When a check in the progress of the patient has been noticed. This ought to be evident from the general condition of the patient the temperature chart, and the rate of the pulse and respiration.
It is worse than useless to wait until there are gross signs of failure and only a careful following of the case will save the patient from the unjustifiable performance of forlorn surgical measures.
- ii. If after the lapse of a week or ten days there is still evacuation of large quantities of foul sputum, and in the absence of an improvement in the patient's general condition then it is safe to assume that the natural cure of emptying of the abscess through the air tubes will not come to pass and more active measures will have to be adopted.
- iii. When it becomes known that the abscess has become localised either by physical examination or by the use of X-Rays, this again shows the necessity for more active surgical measures.
- iv. If the abscess becomes approachable by exploration with a needle, and pus can be withdrawn, that is a clear indication for active surgical intervention.
- v. The rupture of an abscess into the pleural cavity causing an empyema calls for surgical treatment and drainage.

II. ACTIVE SURGICAL TREATMENT.

THE ANAESTHETIC.

There is a great deal of contention as to the particular form of anaesthesia to be adopted, and let it be said that the necessity for skilled administration of the anaesthetic is of paramount importance. A brief review of the various methods employed will be given here.

(1) LOCAL INFILTRATION.

For this purpose a 2% solution of Novocaine is used. This is injected under the skin and under the skin into the deep tissues as far as the pleura on each side of the rib, as the proposed site of resection. It is well to use this method of anaesthesia in all debilitated cases and may be used as a routine in adults, but it is not so successful in children and young subjects.

This method avoids the shock associated with the administration of a general anaesthetic and is the method of choice.

(2) REGIONAL ANAESTHESIA.

By this method anaesthesia is established by the perineural injection of novocain solution. Several/

Several c.c's are injected around the head of the rib to be resected and also around the head of the rib above and below.

The skin, the rib and all the tissues to be divided will be rendered anaesthetic and this method can be recommended for routine procedure in adults.

(3) GENERAL ANAESTHESIA.

Gas and Oxygen A.C.E. Chloroform and Ether are the anaesthetics generally used for the induction of a general anaesthesia.

The anaesthetic of choice is Gas & Oxygen as it is accompanied by the least degree of shock and is not usually followed by unpleasant sequelae. The apparatus is cumbersome and not easily portable and requires the services of a more skilled operator than any of the others.

A.C.E. is useful especially in children and Chloroform is easily and pleasantly administered in these cases but either may be dangerous if not carefully and slowly administered. Ether is not recommended.

Shortly it may be said:-

- (a) Local anaesthesia should be used in adults and in/

in cases in which the patient is debilitated.

- (b) Gas & Oxygen is the general anaesthesia of choice if available.
- (c) A.C.E. mixture is useful failing the other and is particularly useful in children.

INCISION.

The site of the incision and the field of operation will depend entirely upon the localisation of the abscess. Exploration with a needle must be undertaken immediately prior to operation to make sure that pus is still there.

The parietal pleura is exposed after a resection of a portion of a rib and the ribs above and below are retracted with a rack and pinion retractor. In a great many cases the two layers of pleura are adherent and in these cases the abscess may be opened by the insertion of a pair of sinus forceps.

In the cases in which the pleural layers are not adherent care must be taken to avoid the soiling of the pleura cavity when the pleura is opened.

This is done in one of the following ways:-

The Parietal and Viscera layers are sutured together around the proposed site of entry into the abscess or alternatively the parietal pleura is well painted with Iodine and the periphery of the wound is firmly packed with guaze.

The/

The actual opening of the abscess is not undertaken for at least 5 days after which time the abscess can be opened and the drainage tube inserted.

Irrigation is practised in some cases but as a rule is not necessary. Dakin's solution is strongly recommended by some authorities. After-Treatment is of very great importance but will be mentioned when the question of empyema is dealt with.

SUPPURATION IN THE BRONCHIAL TUBES.

I. ACUTE PURULENT BRONCHITIS.

This condition is not usually classed as a variety of intrathoracic suppuration and it is mentioned since any discussion on the subject of Pulmonary Suppuration would not be complete without it. This condition occurs more frequently in old people and children and is more serious at those ages. It may also recur at the same time each year and it may have a seasonal incidence.

It has been recorded as being at times infectious and rarely epidemic but it is not due to the Bacillus of Influenza.

Various/

Various organisms are found in the examination of the sputum and the Pneumococcus the Streptococcus the Micrococcus Catarrhalis and the Bacillus of Pfeiffer are most commonly found.

It would appear from the experience during the War period of 1916-17 that overcrowding in huts and general debility were predisposing factors and it was then looked upon by some as a new disease. It is probably the same condition as was previously known as "Suffocative Catarrh".

The Morbid Anatomy of this condition shows a very intense inflammation of the medium sized and smaller bronchi with an exudate rich in leucocytes. This may extend to the Alveoli and there may be there fibrinous fluid containing red cells. The condition is bilateral and almost universal. This condition is commonly found post mortem associated with broncho-pneumonia but it occurs quite independently of pneumonia consolidation.

II. ACUTE BRONCHIECTASIS.

In these cases the bronchiectasis is usually found to affect the medium sized bronchi but it may affect the smaller tubes or terminal bronchiole and then it is termed Acute Bronchiolitis. It is more common in children than adults and this is probably/

probably due to the greater resistance to infection and the greater strength of the wall in adult than in the child.

MACROSCOPICAL APPEARANCES.

The dilatation of the bronchi in this condition is not so pronounced in this condition as it is in Chronic Bronchiectasis, nevertheless, there may be demonstrated in some cases a degree of cylindrical dilatation and at times even saccular or fusiform shapes, the walls are thin and for the most part smooth being covered by the viscid purulent or mucopurulent contents of the bronchi.

These changes are most frequently found in the lower lobes but are by no means confined to that part; in infants the condition exists as a rule on both sides and throughout the lung.

The site may vary according to the cause of the condition as will be understood. There are not any large bronchiectatic cavities, indeed these are only found in the chronic type of Bronchiectasis.

As has been mentioned above bronchopneumonia was a common accompaniment of acute bronchiectasis and the lung exhibits at times and in places partial or total collapse.

MICROSCOPICAL/

MICROSCOPICAL APPEARANCES.

The dilated bronchi contain pus cells necrotic debris and occasionally epithelioid cells with numerous and various organisms.

The air tubes are lined with transitional epithelium in some cases, in others by squamous and columnar epithelium and at times the epithelial covering is absent.

The wall of the tube is infiltrated with plasma cells, and there is evidence of destruction of the elastic tissue within the wall and sometimes the wall cannot be identified.

Pneumonic consolidation is found in the tissue surrounding tubes and in places there is an interstitial fibrosis.

ETIOLOGICAL FACTORS.

Broncho-pneumonia in children.

This is a very important cause of Acute Bronchiectasis and probably accounts for 50% of the cases. Of these some cases are due to a primary broncho-pneumonia and no other factor causing debility appears to be operating. In others the broncho-pneumonia was secondary to other causes, that is to say, there is some condition present before/

before the broncho-pneumonia supervened as a complication and of these may be mentioned gastro-enteritis specific fevers marasmus and minor operations.

Again acute bronchiectasis may result in Pulmonary Tuberculosis only where there is a pre-existing Pulmonary tuberculosis and a broncho-pneumonia has been superimposed upon it.

BRONCHO-PNEUMONIA IN ADULTS.

In these cases the broncho-pneumonia is usually the end disease of a cachexia due to malignant disease, either in the oesophagus or the thyroid gland or of the lung itself or merely as the terminal event of a generalised condition. A secondary carcinomatous deposit has been found to include a bronchus. Other cases are due to or followed by operations under general Anaesthesia and in some the broncho-pneumonia was merely the terminal disease of a general cachexia.

INHALATION OF FOREIGN BODIES.

The inhalation of a foreign body followed by its arrest in the lower air passages has been followed by bronchiectasis in rare instances.

CARCINOMA/

CARCINOMA OF THE LUNG.

It has already been mentioned that bronchiectasis will follow carcinoma of the lung or a bronchus. The mechanism by which bronchiectasis is brought about is fairly clear. The carcinoma arising as it does in connection with a bronchus infiltrates through the bronchial wall and extends to the mucosal surface of the bronchus. Then it proceeds to obliterate the lumen, partially at first and then completely. This results in the retention of infected material and bronchiectasis with broncho-pneumonia and collapse in the affected portion of the lung inevitably follow.

DIAGNOSIS.

In spite of the apparent ease of explanation of the aetiology of the condition of acute bronchiectasis the diagnosis is one of extreme difficulty and it must remain mostly a matter of speculation. The fact that Broncho-pneumonia is a constant concomitant of the bronchiectatic condition clouds the issue, and most cases will be regarded clinically as simply a broncho-pneumonia.

The Sputum is not voided in large quantities in this condition and does not possess the characteristics/

characteristics of that voided in an established Chronic Bronchiectasis and the rapid course of the disease does not allow of the clubbing of the fingers to develop as obtains in the chronic form.

Intratracheal injections of lipiodol would be absolutely unwarranted in the case of an extremely ill patient, and in any case the treatment followed would be the same as that of a broncho-pneumonia.

TREATMENT.

The most important factor in treatment is the prophylaxis. It should be stressed that the greatest care should be exercised in the handling of children recovering from conditions which predispose to Acute Bronchiectasis, particularly in children recovering from Measles, Whooping cough and other specific fevers.

Adults should be kept in bed but children should be kept in a cot and not overclad. The position in bed should be changed frequently to assist the emptying of the air passages.

The room should be well ventilated and kept at a constant temperature and a steam kettle is useful.

The diet should consist of milk and milky foods and plenty of ~~fluids~~ should be administered.

The/

The bowels should be carefully regulated, but not purged. Mild Saline purges are all that are necessary.

Brandy is the best form of alcohol to administer and up to an ounce of brandy a day may be given.

Antipyretics are best avoided but tepid baths may be given if the temperature is high with considerable relief to the patient.

Inhalations containing Balsam of Peru may be given and expectorants may be prescribed if the cough is dry. Mostly expectorants tend to upset the digestion and are best avoided if not called for.

CHRONIC BRONCHIECTASIS.

This is a comparatively common form of intrathoracic suppuration.

MORBID ANATOMY.

Macroscopically the appearance of the lung is characteristic. The bronchial tubes are dilated to a varying degree and in some cases the dilatation may result in the formation of large spaces or cavities. The dilatation may extend for a considerable portion of the bronchial tube in what is called the cylindrical or digitate type of the disease. When the dilatation is more localised the condition tends to become/

become saccular and this type generally follows a primary peribronchial fibrosis, in a few cases the puckering of the bronchial wall due to the contraction of the fibrous tissue can be seen. Less often the dilatation is what is called fusiform. In these cases the wall appears thin, it is usually smooth but may show signs of ulceration.

Microscopically the lumen of the bronchial tubes contains pus cells, desquamated epithelium and organisms. The wall of the bronchus is thickened and shows signs of infiltration with plasma and mononuclear cells. The elastic fibres and muscle coats are almost completely absent and replaced by fibrous tissue.

The cartilage is also replaced by fibrous tissue. The infiltration may extend into the adjacent alveoli which collapse and are lined with cubical epithelium.

METHOD OF PRODUCTION.

This is of course largely theoretical but without doubt the essential feature is the weakening of the bronchial wall, and whatever brings about that weakness may be a factor in the production of Bronchiectasis.

These factors are:-

- i. Infection of the Bronchi is a very powerful cause/

cause. This may be a purely local condition as in the case of an impacted foreign body or it may be widespread and affect most of the bronchial tree as occurs in the case of bronchiectasis following Chronic Bronchitis.

ii. Retention of Secretions. This predisposes

to infection and aids the destructive process. The retention may result from one of three causes.

- (a) There may be excessive secretion.
- (b) Obstruction of the lumen may prevent removal by expectoration.
- (c) Loss of elasticity may prevent the necessary vis a tergo to expel the secretion.

iii. Obstruction of the lumen. This may be due to a foreign body lodged in the bronchus or the bronchus may become obstructed by pressure from without as by an aneurism or other tumour, in which case the distal part of the bronchus becomes the seat of a bronchiectasis.

iv. Fibrosis. This is a fruitful cause of Bronchiectasis and the explanation is that the resiliency of the pulmonary tissue is destroyed/

destroyed and the infection which ensues causes the bronchiectasis.

- v. Cough. The presence of a chronic cough is an additional factor in promoting dilatation of the already weakened wall of the bronchus. The intrapulmonary pressure is raised during the closure of the glottis.
- vi. Congenital Factor. It is sometimes said that there is a congenital factor in the production of emphysema and some cases of congenital bronchiectasis have been described but the influence is doubtful.

AETIOLOGICAL FACTORS.

- i. Chronic Pulmonary Tuberculosis. This is by far the commonest cause of Chronic Bronchiectasis. It is the cause in probably 50% of cases. The lesion may not of necessity be an extensive one and clinically the presence of Pulmonary Tuberculosis may not be suspected. In some cases there is evidence of other scarring and calcification and in some cases the patient dies from the Tuberculous disease. The disease may be confined to one side & the rate of incidence is about equal, & a great many cases occur at the apex of the lung. It may be bilateral. In children the condition may occur in the lower lobes, in adults if the condition occurs in the lower lobes the upper lobes are affected as well.
- ii. Fibrosis of Lungs. This is the next most common cause after Tuberculosis of the lungs. In a great many of these cases a history of acute disease is obtainable and the patient generally gives a history of/
of/

of many and repeated attacks of cold on the chest, but the post mortem findings may show that the condition is not due in any of such cases to a tuberculous process and may be regarded as a pure fibrosis, due to a non-tuberculous infection. The bronchiectasis may in these cases be very extensive and is usually more extensive in distribution and more massive in type.

- iii. Chronic Bronchitis. This usually occurs in the case of elderly people who have suffered from Chronic Bronchitis for many years. It is a generalised condition and is not as a rule of a severe character.
- iv. Pressure from Caseous Glands. This may occur in children particularly and is probably not an uncommon mode of production. In these cases the pressure is exerted on the bronchus causing occlusion in part or as a whole and the bronchiectasis results in the distal part of the affected bronchus.
- v. Pressure by Aneurism. This is brought about by pressure by an aneurism of the descending part of the aortic arch on the left bronchus./

bronchus, and it has been known that the aneurism may burst into the bronchus which it has so affected.

- vi. Foreign Bodies in Bronchi. This is not a common cause of Bronchiectasis. The same mechanism operates in bringing about the bronchiectatic condition as in other cases of obstruction, and there may be associated a very considerable interstitial fibrosis of the lung.
- vii. Anthracosis. There may be some doubt as to whether in these cases the condition is due to an infection or whether the resultant bronchiectasis is brought about by the irritation of the particles of coal dust. It is probable that a secondary infection supervenes on the anthracosis if bronchiectasis develops.

SYMPTOMS OF CHRONIC BRONCHIECTASIS.

The symptoms of the disease are as a rule fairly typical and the early diagnosis of the disease is of paramount importance if there is to be any prospect of success in treatment. Tuberculous Bronchiectasis particularly what is called Focal Apical Bronchiectasis becomes a condition in which the treatment/

treatment of the tuberculosis is the important matter and only non-tuberculous bronchiectasis will be considered.

The general appearance of the patient is little if any altered. There may be some pallor and the general health is often quite good. There is, as a rule, no fever and if it is present, it is due to a superadded bronchitis. 7

Cough is generally present and characteristically paroxysmal. There are two occasions in the day when severe paroxysms occur, first in the morning due to change of posture and the inevitable irritation of the bronchial wall by the retained secretions, and the second at night often just before retiring to bed.

Sputum is usually expectorated in large quantities particularly in the cases of long standing.

The odour is of an offensive character with a peculiar sweetness, and when allowed to stand it separates out into three distinct layers. The uppermost layer is frothy, the middle is fluid in nature, and the lowermost is a heavy deposit which contains pus leucocytes and lung tissue. Foetid yellow bodies called Dittrich's bodies are found in the bottom layer.

Haemoptysis is present in some cases but in the non-tuberculous cases is not common and is usually/

usually little more than a tingeing of the sputum with blood.

PHYSICAL EXAMINATION.

The signs vary naturally with the extent of the disease, which is often unilateral and there may be flattening and diminished movement of the chest over the affected part. The heart may be displaced over to the affected side, owing to the presence of Fibrosis of the lung.

Tactile Vocal Fremitus is diminished and the Percussion note is impaired. The signs on Auscultation will vary according to the presence of cavity formation, and whether the cavity is full or empty. If full, the sounds are diminished or absent and adventitious sounds are absent or few.

Vocal resonance is diminished. If the cavity be empty the sounds become cavernous in quality or amphoric if there be a large cavity, and there are also present crepitations, rhonchi, and whispering pectoriloquy.

Clubbing of the fingers and toes is prominent if the condition has persisted for any length of time, and this clubbing of the fingers is much more marked in the non-tuberculous form of Bronchiectasis than in the tuberculous form with an extensive cavitation/

cavitation, and the clubbing begins very much earlier in the non-tuberculous type.

SPECIAL METHODS OF INVESTIGATION.

The Sputum should be examined at least three times for Tubercle Bacilli and the faeces also should be examined for this organism.

X-Ray photograph should be taken of the chest and be a routine in all cases, more particularly should this be so, if there be a doubt after the proper consideration of the history and carefully physical examination.

A stereoscopic photograph is of much greater value than one simple film. The presence of fibrosis and the range of movement of the diaphragm should be noted on screening, and a foreign body should always be looked for. Cavity formation is usually, easily detected in the Radiogram.

LIPIODOL AND X-RAY COMBINED.

This is an extremely valuable means of examination and whereas it is almost impossible to detect the nature and extent of bronchial deformity by ordinary means, the use of lipiodol often enough proves of the greatest value.

The method of use of lipiodol should be mentioned. The substance consists of a solution of iodine/

iodine in Poppyseed oil.

There are two methods of introduction of the substance into the air passages, firstly by the mouth and secondly by the direct method cricoid cartilage.

The method of introducing the lipiodol through the mouth is done by means of a catheter placed along the tongue, and in certain cases and in the hands of certain operators, it seems to be satisfactory, but it is not so certain as the direct method, and the patient is very apt to swallow the whole of the lipiodol.

In the second or direct method the patient is placed on a couch in the X-Ray room and is made comfortable by being propped up on pillows. The skin at the region of the cricoid cartilage is thoroughly cleansed and anaesthetised with 2% Novocaine which is carefully injected under the skin.

The cricoid cartilage is then firmly fixed by holding it with the finger and thumb of the left hand. A hypodermic syringe containing novocaine is then plunged into the trachea at right angles to the skin, the piston is withdrawn to make sure that the needle is in the trachea, and the solution is quickly injected into the trachea, the patient being warned to/

to refrain from coughing whilst this is done.

The second injection of novocaine is not absolutely necessary, but it adds to the prospect of success in the venture.

The lipiodol is then introduced into the insensitive trachea. The lipiodol is carefully warmed in its container and placed in a large syringe, 20 to 30 c.c's.

A special needle is then introduced through the anaesthetised skin, a stout needle of large bore with a special grip and to this needle the syringe is attached.

The patient may be kept on whatever side the lesion is expected to be found, or both sides of the chest may be investigated at the same sitting.

The lipiodol is slowly injected by a screw like motion of the piston of the syringe, and after a few minutes the patient is examined radiographically in the erect and supine positions at least.

There is one word of warning about the use of lipiodol. Some patients have a marked idiosyncrasy to the preparation and it is advisable to give some doses of Sodium or potassium iodide for a day or two, before the examination is carried out if this can be done.

The greatest value of the lipiodol examination lies not in the fact that cavities can be detected/

detected by its use but the size and locality of the cavities can be made out, a very important finding when surgical treatment has to be considered.

COMPLICATIONS OF CHRONIC BRONCHIECTASIS.

I. Recurrent attacks of bronchiectasis.

These attacks are almost a constant feature of chronic bronchiectasis. There is an exacerbation of the symptoms, the cough becomes more prominent, there is fever and generalised crepitations are heard all over the chest on auscultation. The attack is usually of short duration and the condition subsides after a few days rest confinement to bed is indicated.

II. Arthritis.

Multiple joint pains commonly accompany chronic bronchiectasis. The joints are not as a rule swollen but very occasionally there may be a form of arthritis very like Rheumatoid arthritis may develop.

III. Septic Bronchio-pneumonia and Pericarditis.

May be a terminal feature of the disease.

IV./



IV. Abscess of the Brain.

This is the classical complication of Chronic Bronchiectasis and is generally the sole manifestation of a condition of Pyaemia. The abscess is due to embolism of a fragment of infected material becoming detached from a thrombus in a Pulmonary Vein passing into the general circulation and becoming lodged in a terminal branch of the cerebral arterial system. It is fairly common as a result of Chronic Bronchiectasis. Acute Bronchiectasis does not give rise to this complication. The abscesses may be single or multiple, in the former case the abscess is of much greater dimensions than in the case of multiple abscesses, and the site of the abscess is usually the cerebrum. It is interesting to note that advanced pulmonary tuberculosis very rarely is complicated by abscess of the brain even when there is extensive disease and cavity formation.

V. Hypertrophic Pulmonary Osteoarthropathy.

Clubbing of the fingers is usually found
in/

in some degree in almost all cases of chronic bronchiectasis but it is not often that pulmonary hypertrophic osteoarthropathy is found.

VI. Lardaceous Disease.

This may occur in some cases but is rare. Gangrene of the lung and Pyo-pneumo-thorax may also occur.

TREATMENT OF CHRONIC BRONCHIECTASIS.

It is unfortunate that even the most energetic measures prove abortive in a great many cases of Chronic Bronchiectasis, and in those cases the alleviation of the distressing symptoms of the disease is the sole aim in treatment. Palliative treatment should be carried out in all cases in which the general condition of the patient precludes surgical interference, when any of the complications of bronchiectasis have supervened, when the disease is bilateral and when the cause of the disease can be ascertained as due to pressure of an aneurism of caseous tuberculous glands, or in the presence of extensive pulmonary tuberculosis. If the condition be due to the lodgment of a foreign body in a bronchus then steps should be taken to remove the foreign body, but it/

it can be said generally that the treatment will depend usually on the aetiological factors involved.

Treatment resolves itself into three distinct varieties:-

- i. Prophylactic.
- ii. Medical.
- iii. Surgical.

- i. Prophylactic treatment. Consists of course in trying to prevent the disease. The preventive treatment can be of immense value and numerous cases can be said to be due to neglect of active treatment following pneumonia. From this arises the important question of the convalescent period of those recovering from pneumonia and it should be insisted that in the cases showing signs of delayed resolution the convalescence should be prolonged and all forms of strain on the respiratory system should be avoided. The removal of the patient from the murky atmosphere of a town to the clear air of the country and the seaside is very advantageous and the exposure of the body to direct sunlight or to mild seabathing are to be strongly recommended./

recommended. In this country where sunlight may not be available ultra violet rays may be substituted as an alternative.

Diathermy. Is also useful and breathing exercises may be used with advantage if properly supervised and regularly performed. There is a certain amount of risk attached to the promiscuous prescription of breathing exercises and the modus operandi should be laid down for the patient. Proper nourishing food is indicated, and above all an axiom of "festina lente" should be adopted.

- ii. Medical Treatment. Some measures have been already mentioned that come into this category but the insistence of ample rest as a feature of the treatment should be stressed. If there be any pyrexia then the patient should be kept at absolute rest. All foci of possible infection should be cleaned out, particularly should the teeth be properly and thoroughly investigated for infection and the throat and accessory sinuses should be investigated for possible/

possible trouble.

Vaccine treatment. Has been used in a great many cases and with a very limited success. Cases of severe reactions and in some cases fatalities have been recorded but experience as a rule does not show anything so drastic resulting from the treatment, in fact it is surprising how very large a dose of an autogenous vaccine can be tolerated by these patients.

Colloid injections Neither with vaccines or alone have been tried and recommended, manganese, particularly has been suggested. Iodine in solution or iodoform in solution have also been made use of, and in some cases there appears to be some benefit. It is just as well to point out, that in these treatments hospital is the best place for the patient, from the patient's point of view and that of the attending physician.

Postural Treatment. This is one of the most valuable of all the treatments in Chronic Bronchiectasis, and should be practised/

practised regularly at least twice a day. Whatever method is used the essential feature of the posture is the lowering of the head and shoulders below the level of the thorax and the easiest method of doing this is simply by lowering the head and shoulders over the edge of the bed having a receptacle into which the bronchial contents can be collected. The alteration in position causes the contents of the cavities to reach the healthy bronchial mucosa and this sets up a coughing which eventually clears out the bronchial system. In those cases in which the patient is either too ill, or they find the act too exhausting, it will be found that gradually lowering the head of the bed is advantageous, leaving the patient supine and without pillows. If this procedure is carried out regularly and systematically the patient, as a rule, gets immense relief for practically the whole day, and usually has an almost uninterrupted night.

The Creosote Chamber. This method of treatment is almost impossible to carry out in
a/

a private house owing to the smell of the fumes, and indeed in Hospital where it can be carried out it is difficult to persuade the management of the advantages to be gained by the patient and incidentally to the other patients in the wards. The patient must be able to be moved from his bed and preferably should be an ambulatory case. A chamber is easily and readily manufactured, or better still a small room is used for the purpose.

Crude creosote is evaporated by means of a lamp, and the patient sits in the room with his eyes covered and his ears plugged. The length of time during which the treatment should take place varies with the individual but, as a rule, the duration should not exceed fifteen minutes. The treatment can be carried out daily, but alternate days is usually often enough. In one case under observation, the patient was able to stand treatment every day and made considerable progress. The treatment benefits the patient in two ways. The cough set up by the fumes causes a "toilet"/

"toilet" of the chest and the action of the creosote removes the offensive odour to the satisfaction of the patient and friends.

INHALATIONS.

The inhalation of various medicinal substances is useful and this can be done by means of an inhaler of some type. The treatment requires frequent dropping of the substance used on the inhaler, and the inhaler can be worn either for a longer or shorter period. Iodine, Chloroform, Eucalyptus and Creosote are used.

MEDICINAL TREATMENT.

Very few medicines are of any use in this condition. Iodides are perhaps the most useful of all and can be given over an extended period, and creosote in capsule and up to 5 to 10 drops per dose can be exhibited. They can be given together with advantage. Guaiacol Carbonate has been prescribed and strongly recommended, by some, and sandal wood oil and garlic are sometimes prescribed. The last two have obvious handicaps.

INTRATRACHEAL MEDICATION.

Oily suspensions of volatile oils are being used more and more extensively Lipiodol is perhaps the/

the most useful intra-tracheal therapeutic measure and is now almost in universal use. It has practically no contra-indications except that mentioned under the diagnostic procedure, and it seems to cause very little inconvenience to the patient. Both sides can be treated at the same sitting and only one case has come under personal notice in which the treatment caused serious effects. In this case the patient was seized with severe dyspnoea immediately after the giving of the lipiodol and became cyanosed and collapsed. She soon recovered, however, but it was some days before the irritation of the bronchi had entirely disappeared. It is surmised that the lipiodol was at fault in this instance.

iii. ACTIVE SURGICAL TREATMENT.

It is perfectly plain that no hope can be held out for the cure of a case of Chronic Bronchiectasis once there is distortion anatomically of the bronchi to any extent. In these cases the only reasonable prospect of alleviation of the symptoms lies in surgical interference. There are two considerations which make one pause in recommending these measures and one is the lack of success in a great many of cases, and the other is, the high mortality attendant /

attendant upon operative procedures. There is no doubt as has been mentioned at the beginning of this Thesis that in future with improved technique and other matters, more cases of chronic bronchiectasis will come into the domain of the surgeon. Before resorting to Surgical measures and in order to minimise the risks already mentioned, it is well to survey the prospects in a given case. The general condition of the patient must be favourable, the age must be considered and there must be an absence of any of the complicating factors of chronic bronchiectasis. The disease must be unilateral and localised.

If there be displacement of the mediastinum as indicated by displacement of the heart then that must be regarded as unfavourable to operative treatment.

The various methods of operative procedure are hereunder described:-

LUNG COLLAPSE.

When the condition of the lung reveals only a slight and early change indicative of bronchiectasis collapse of the lung is a useful and justifiable procedure. If there is extensive fibrosis of the lung present the carrying out of this procedure and other methods may have to be resorted to. The first method of/

of inducing collapse of the lung is:-

ARTIFICIAL PNEUMOTHORAX.

This is the simplest of the methods of producing the effect, but the whole point about the treatment is to keep the collapse permanent or at any rate for a prolonged period. This can be done by repeated fillings with air, and it is claimed by some that it is very efficacious. Occasionally it happens that in an early case, one filling is all that is required, but this is very exceptional. The apparatus used is simple and comparatively inexpensive, the technique requires no particular special skill and is not at all dangerous if the patient is well chosen. Occasional cases of pleural shock occur, they are however rare.

OLEOTHORAX.

This device was originated in order to maintain the condition of collapse and to obviate the repeated filling usually necessary when the atmospheric air is used. Olive oil containing 5% of Gomenol in solution is the fluid used and is useful in these cases. The oil remains unabsorbed for a considerable time up to six months. Occasionally there forms a fistula through which the oil escapes, but this occurs more commonly in the cases where an apicolysis/

apicolysis has been done and the puncture or aperture is difficult to seal.

PHRENIC AVULSION.

This is a simple surgical procedure and is most useful in the cases in which the bronchiectasis is confined to the base of one lung. The phrenic nerve is dealt with on the affected side, and the practice of phrenicotomy is not much use. It is practically useless owing to the fact that the innervation of the nerve extends lower down than surgical exposure will admit. In avulsion after exposure the process of avulsion is carried out with great care as it is possible to break the nerve by using too much force. On the other hand if the proper amount of strain be applied the whole of the nerve can be pulled out. The immediate effect of this operation is to raise the diaphragm, which is ipso facto paralysed, up to the level of the 3rd or 4th rib. The lung is collapsed for the most part and the apex of the lung probably enjoys, too, a considerable amount of rest. One striking result is the diminishing of the foetor of the sputum but the amount of the sputum is not necessarily lessened.

THORACOPLASTY.

This is an extensive and serious operation and is not undertaken in any light spirit. Quite apart/

apart from the gravity of the operation from its immediate effects it has to be noted that the results are permanent and mutilating. It is, however, a very necessary proceeding when the condition has spread to affect more than one lobe. There are several operations described, but for the purposes of this Thesis, it is only necessary to indicate, that the operation should be conducted in two stages. In some cases the ribs are only resected posteriorly, in others they are divided both in front and behind. The latter procedure appears to be the more efficacious.

B. DRAINAGE.

This is the method of choice in cases which the condition has been shown by X-Ray and Lipiodol injections to be confined to a lower lobe and the real lesion is the presence of a large cavity. In these cases there is a risk of soiling the pleural cavity, as mentioned in describing the surgical treatment of lung abscess. The affected lung is brought to the surface at the first operation and five days later when the visceral and parietal pleurae have become adherent the cavity is opened up and drained on the surface. There is very great relief in these cases from the diminution of the amount of sputum.

C. LOBECTOMY/

C. LOBECTOMY.

This is theoretically perhaps the method that commends itself as the best for the surgical treatment of bronchiectasis. It is, however, in practice a difficult enough procedure and entails very great risk to the patient. It is absolutely essential in this proceeding to have a lipiodol X-Ray taken immediately prior to the operation for the guidance of the surgeon. There are two grave risks in this operation.

(I) Haemorrhage.

(II) Infection of the Pleural Cavity.

The latter has been already mentioned twice, but in regard to the haemorrhage it has to be remembered that the lung lacks the contractile quality of muscle and other agencies have to be used to enable the lung to be removed under conditions favouring haemorrhage.

The first of these is Diathermy. It is possible by using this method to remove a large portion of lung slowly, and yet keeping the haemorrhage under control. After the operation the wound is carefully, and as thoroughly as possible, packed with gauze, the risk of reactionary and secondary haemorrhage being extremely grave.

CAUTERY/

CAUTERY.

Two kinds of cautery have been used in chest surgery, and in some cases of solitary cavities in the chest the use of a large cautery is made instead of the incision and drainage mentioned above. It is claimed to be successful in its application.

The Steam cautery is another very useful form of cautery which seems to be destined to prove of very great value in the hands of the Surgeon.

The steam cautery has the great advantage in that it is more rapid in its action and enables the surgeon more quickly to enlarge the scope of the operation, at the same time it is more effective than the diathermy or actual cautery in arresting haemorrhage. In both the use of the actual cautery and the steam cautery the danger of an infection of the pleural cavity must not be overlooked.

More recently there has been described a treatment by MARTIN in which the affection is alleviated by carrying out complete aspiration of the bronchus using an aspirating bronchoscope with continuous suction. A two way cannula is employed one tube being used for continuous suction and passed into the cavity is aspirated and dried as far as possible/

Through the second tube of the two way cannula weak boric acid solution is pumped into the cavity which is washed and cleaned. The cavity is then mopped out and dried and may be painted with spirit, the spirit tending to cause a local reaction and promote adhesions. MARTIN claims 15 cures out of 61 cases and there seems to be less risk than in most treatments used. No general anaesthetic is used, and this certainly adds to the attractiveness of the operation.

EMPHYSEMATOUS BRONCHIECTASIS.

This is a rare and interesting condition and is sometimes known as spongy lungs. The distension is not confined to the alveoli as in ordinary emphysema but the bronchial tubes are similarly involved and they become dilated to form large and prominent spaces in the lung substance.

ETIOLOGY AND PATHOLOGY.

The condition is only found in young people as a rule and there is present in most cases bronchopneumonia.

MACROSCOPICAL APPEARANCES.

There are areas through the lungs of consolidation and collapse. Purulent bronchitis and bronchiolitis/

bronchiolitis is present. In the substance of the lung and beneath the visceral pleura there are numerous large emphysematous spaces. Interstitial emphysema is also present.

The Right Ventricle of the heart is markedly hypertrophied. Microscopically in the bronchi the lumen is filled with mucus and occasional pus cells with masses of cocci and bacilli. The vessels are engorged in the walls of the bronchi, but the wall itself is not thickened by fibrosis and the muscle coat is intact and well developed. The elastic lamina is present and intact.

DIAGNOSIS.

The symptoms and signs of this condition are indistinguishable from those of Broncho-pneumonia and the patient who usually is a child, presents the features of fever, cough, dyspnoea and cyanosis.

Coarse or sonorous rhonchi may appear as prominent signs. The treatment is that of Broncho-pneumonia.

PLEURAL SUPPURATION.

Empyema or Acute Purulent Pleurisy is a common variety of intrathoracic suppuration. Its importance to the Clinician ranks more highly than probably all the other forms of suppuration met with in the/

the chest. And again the treatment of empyema is not the empirical or more or less empirical effort described in connection with the other forms of intrathoracic suppuration, and it is so well established and proved that it holds out a very good prospect of success. Yet the treatment of Empyema is by no means at the stage when the final word has been spoken, and unless that which is undertaken is properly and thoroughly performed, with a full realisation of the factors operating, there remains a very high rate of morbidity and not a small rate of mortality.

AETIOLOGY/

AETIOLOGY OF EMPYEMA.

Suppuration becomes established in the pleura in a variety of ways and each will be considered.

I. Following Broncho-pneumonia. In a large percentage of cases empyema appears to arise as a sequel of broncho-pneumonia, and in a great many cases the broncho-pneumonia is itself secondary and has followed operation under general anaesthesia, or as a terminal disease in the course of another disease. The empyema and the broncho-pneumonia may be unilateral even if a purulent bronchitis exists on the other side. In cases where the broncho-pneumonia is primary, the majority of cases occur in children. Multiple lung abscesses may occur as an addition to the broncho-pneumonia.

II. Following Lobar Pneumonia. This also is a common cause of empyema and in most cases of death from this cause the immediate cause is heart failure, but many develop in addition to their empyema, pericarditis, peritonitis and meningitis of pneumococcal origin. In cases/

cases where an operation has been performed for the relief of empyema, and when a double empyema is suspected, even exploratory paracentesis of the fairly sound side is fraught with danger. One such case is recorded here with one lung in a state of collapse, an artificial pneumothorax was established with sudden death as a result.

III. Following Extension of Suppuration from Abdominal Cavity. Already in the course of this thesis the spread of sepsis as a cause of non-embolic lung abscess had been mentioned. Extension of suppuration within the abdominal cavity through the diaphragm and resulting in an empyema is not common. Most of these cases are confined to the right side and the primary lesion in the abdomen, are perforated gastric or duodenal ulcers and acute appendicitis. X

IV. Empyema as part of a Systemic Pyaemia. This as has already been said, occurs of embolic lung abscess, and it can readily be understood that this is a common cause of empyema in pyaemia when it is remembered that there is a/
a/

a tendency for the abscesses to form just under the pleural surface. It often happens that the abscess formed bursts into the pleural cavity.

- V. Other causes may be the rupture of Tuberculous cavity in which secondary infection exists and empyema may develop in the course of the infections fevers. In these latter cases the condition is almost always secondary to a broncho-pneumonia and, therefore, come into the first group mentioned. Punctured wounds of the chest and compound fractures of the ribs may lead to the establishment of an empyema or a pyopneumothorax. Age is an important factor in the development and the younger the child the greater the tendency for a pleural effusion to be purulent. It is common under 10 years of age and between 20 and 40. It is more common in males than in females.
- L.S.

BACTERIOLOGY.

The commonest organism by far is the pneumococcus which accounts for at least half of the cases, mixed infection accounts for a great many and the staphylococcus aureus and the streptococcus are not infrequent. The influenza bacillus of Pfeiffer and the pneumobacillus occur too, and in those cases in which there is a spread from the abdominal cavity, the Bacillus coli is found.

ANATOMICAL DISTRIBUTION.

- i. Generalised Empyema. These cases may occur either when there has been no formation of limiting adhesions or where there has been a rupture into the pleural cavity of a lung abscess.
- ii. Loculated Empyema. In these cases pocketing or localisation of the empyema occurs and three varieties are described,
 - (a) Apical Empyema. This is found in young children as a rule but has been seen in adults, and may persist for a considerable time. One case had persisted for several months according to the history given, and another case seen, emptied itself the day after the diagnosis was made and was cured.
 - (b) Low/

- (b) Low Empyema. This variety of empyema forming over the lower lobe of the lung is the one most commonly met with. These cases also exhibit loculation and may persist for some time.
- (c) Basal or Diaphragmatic Empyema. In this variety the collection of pus is confined inferiorly over the base of the lower lobe. In these cases the empyema is due to the spread of sepsis via the diaphragm from the abdominal cavity.
- iii. Interlobar Empyema. This is applied to those cases in which the suppuration is encysted between the lobes of the lung. Clinically it may be extremely difficult to detect and often is only localised by the use of X-Ray photography.

DIAGNOSIS/

DIAGNOSIS OF EMPYEMA.

If the patient has been under the supervision of an alert physician, the development of an empyema as a complication of either broncho or lobar-pneumonia seldom escapes his notice, the retardation in the progress of the patient giving him a very plain hint as a rule. In those cases in which the development is insidious or in which the pus is, so to speak, hidden and in these cases the physical signs may be very obscure, such as is the case in Inter-lobar, Apical, and Basal or diaphragmatic empyema and these may evade recognition early. The fever in the cases following Lobar-Pneumonia, the temperature after reaching the normal level either by crisis, or by lysis, again becomes remittent or intermittent in type. This may occur after the temperature has remained normal for a day or two but commonly the pyrexia is a continued one.

Other symptoms of septic poisoning occur, pallor, sweating and increased pulse rate, and there may be some degree of dyspnoea present.

On examination there are signs of fluid in/

in the chest. The affected side of the chest does not move as well as the sound one, and in children there may be bulging of the intercostal spaces and tenderness on pressure may be a prominent sign.

The heart is displaced to the opposite side, tactile vocal fremitus is absent and there is stony dullness on percussion.

Breath sounds may be absent, and the vocal resonance is diminished a rule.

There may be aegophony and skodaic resonance may be present, these signs being present above the level of the fluid. The three important points in the diagnosis of fluid in the chest are:-

- i. Stony dullness.
- ii. Cardiac displacement.
- iii. Absence of Vocal Fremitus.

Vocal resonance cannot be regarded as of prime importance and the character of the breath sound is very variable. There may be clubbing of the fingers in long standing cases and occasionally the empyema may find its way to the surface, then being known as an empyema necessitatis.

BLOOD EXAMINATION.

The estimation of the leucocytes in cases where the physical signs indicate the presence of fluid/

fluid is very important and a leucocyte count exceeding 10,000 per c.mm. especially if 70% or more are polymorphs is strongly in favour of a purulent effusion. The leucocytosis is not as a rule extreme and it is unusual to find a very high count but it may be as high as 24,000 per c.mm.

X-RAY EXAMINATION.

For the diagnosis of the more obscure and difficult cases this examination is one of the most valuable to the clinician.

The shadow due to the fluid can be seen and can be proved by observing it in different postures. The heart can be seen displaced and the limitation of the movements of the diaphragm can be noted particularly in the cases of basal empyema.

EXPLORATORY PARACENTESIS.

This is a most important minor operation and should be done in all cases even if fluid is merely suspected as it causes very little inconvenience to the patient if properly done, and if the result is positive, leaves no doubt in the mind of the/

the clinician.

In cases in which no fluid is found at the first exploration, the procedure must be repeated if the symptoms and signs persist, and it certainly can do no harm, further it is a matter of clinical experience that in cases of delayed resolution the mere stimulation of the puncture of an unfruitful paracentesis has resulted in a complete resolution of the pneumonic process. X

It is just as well to mention that, whereas the physician regards this matter of very little importance and hardly any risk, the patient and his friends regard it with considerable awe, and cases have been recorded of accidents due to "Pleural Shock".

The patient should be in bed, as comfortably situated as possible and due precautions taken as to antisepsis, but there does not ever appear to be the necessity for the elaborate ritual practised by some Clinicians.

It is well in cases in which exploratory puncture is undertaken, to bear in mind the superficial anatomical markings of the interlobar septum of the affected part, in fact it is a good idea to mark/

mark out this landmark before proceeding to the paracentesis. Especially so in the case of inter-lobar empyemata, and in other cases it is necessary to make the site of the puncture correspond with the part in which the physical signs are most marked.

MORTALITY RATE.

There are various figures quoted as to the mortality rate in this condition and in round figures the rate is approximately 16%. Some authorities quote as high a rate as 60½% in a series of 100 cases and again as low as 8% in a similar series in the same epidemic. These cases were due to a haemolytic streptococcus and were treated on different lines.

Generally speaking the highest mortality rate in this condition is found in the very young, and in those over 50, in older children and young adults the prognosis is very much more favourable.

Empyema is a very rare occurrence in children under one year of age, but it is a very fatal condition when it occurs. The causative organism is of importance in the ratio of mortality, and in cases of mixed infection the death rate is usually/

usually higher. The average stay in Hospital is about 5 weeks but it may be as long as 3 months or more.

A great many cases leave the Hospital with unhealed sinuses and nearly 25% are readmitted to Hospital for a recurrence of the empyema or for the treatment of a discharging sinus. The prolonged state of morbidity emphasising, as it does, the very great economic loss attributable to empyema coupled with high mortality, renders the question of treatment a very important one.

TREATMENT OF EMPYEMA.

The essential treatment of empyema does not differ in its basic principles from the treatment of suppuration occurring in other parts of the body. The old adage "If you find pus, let it out" holds good in its charge here as elsewhere, and it becomes imperative to remove the pus in empyema, either by incision and drainage or other means at disposal.

The considerations as to the time and method of evacuation of pus, in the case of treatment of empyema/

empyema, are often of supreme importance and they must be carefully considered.

TIME FOR OPERATION.

The operation for empyema is seldom if ever an emergency operation and too great haste may spell disaster when a hand stayed and a little patience might have had due reward, in children the question of delay in proceeding to the operation is of the most emphatic importance.

The initial pneumonic complaint tends to be a more tedious and prolonged illness in children than in adults, the process lasting not seldom, even in a case without any complications from 10 to 14 days. This possibility should be well borne in mind when the presence of an empyema is established in the course of an illness.

The main point here is, that the child is not suffering from the effects of the empyema, so much as from the active pneumonia, and since the two conditions exist contemporaneously they may be called synpneumonic empyema. It is very important not to try to resect a rib for the relief of a synpneumonic empyema until the pneumonic process has terminated.

The/

The condition can be relieved by aspiration as a palliative until the pneumonia has subsided, and it is so important a matter to deal conservatively with these cases, owing to the likelihood of causing a fatal issue due to pneumonia. In older children and adults the empyema is established after the pneumonic process has subsided, and may then be termed a meta-pneumonic empyema.

The formation and presence of adhesions strong enough to prevent the collapse of the lung when the cavity is opened, form a second important consideration as to the time of the operation. Aspiration should be employed until the surgeon is reasonably sure that this state of affairs exists within the thoracic cavity. If an exploratory paracentesis has been performed and thick pus has been withdrawn this is usually a fairly safe indication that these adhesions are present. The presence of thick pus and the presence of the pneumococcus, postulates adhesions with a large deposit of fibrin. If the fluid is thin or only turbid, and due to the presence of the streptococcus, the operation should not be hurried and repeated aspirations should be resorted to until a later date.

CHOICE/

CHOICE OF OPERATION.

i. Repeated aspiration. In a very few instances it may be found that serious operative interference may be avoided and repeated aspirations may be all that are called for. If early in the disease the pneumococcus is recognised as the causative organism, this procedure may be entirely successful, and in children particularly, it is to be noted, that aspiration is to be preferred, as a routine, rather than the more drastic thoracotomy, especially in view of the serious mortality rate associated with the latter operation.

The repeated aspirations do not preclude the performance of a rib resection, and really should rather be regarded as a preliminary to that step, more particularly when the character of the pus suggests that adhesions have not formed. Aspiration is, therefore, a favourable and commendable procedure in all cases of synpneumonic empyema in children.

It is also a better means of dealing with the case when there is considerable pressure, the release of the pressure gradually being much less likely/

likely to be fraught with disaster than a sudden withdrawal of fluid, and the consequent rapid disturbance of the intrathoracic pressure with disastrous results as was witnessed in one instance.

ii. Intercostal Incision. This procedure is found to be ample occasionally in children and certainly in debilitated subjects, and is, of course, followed by drainage as in the rib resection cases. The great difficulty in these cases, is to keep a free drainage, but it has been found in experience that, a large enough incision to admit of the use of more than one drainage tube side by side, improves the drainage, but it is not a good way of dealing with the case, and almost of necessity, on account of the disability mentioned, the more extensive operation becomes imperative sooner or later.

iii. Resection of a Rib. This, in most instances, is the method of choice and may be adopted as a primary measure in meta-pneumonic abscess, or as a secondary measure in a pneumonic empyema, after repeated aspirations, and following the incision of the chest in debilitated subjects.

The site of the rib resection should correspond/

correspond to the most dependent part of the pus collection, with the patient in the semi-sitting position. Two precautions are important in deciding the site of the operation.

- (a) The pleural cavity should be opened not too low down as the wound tends to be occluded by the diaphragm. The 8th rib in the posterior axillary line and the 6th rib in the mid-axillary line mark the lowest limits for rib resection.
- (b) The wound must be situated in such a way, that the proper drainage of the wound is not interfered with, by the movements of the scapula.

Immediately on opening the pleural cavity the pus escapes and on this, some prefer to irrigate the pleural cavity. This is not a necessary procedure and is not devoid of danger. Detached sloughs should be removed but the adhesions existing between the lung and the chest wall should not be disturbed.

METHOD/

METHOD OF DRAINAGE.

1. OPEN METHOD.

The question of the type of drainage tube is really unimportant. What does matter is that the bore of the tube shall be large enough, and the tube be of firm consistency. The tube should be about $\frac{1}{2}$ inch in diameter, the outer end should be split and transfixed with a stout safety pin, to prevent the recession of the tube into the thoracic cavity. More elaborate devices have been invented and are used but for all practical purposes nothing is gained by using them.

A good thick dressing of gauze is applied to the wound and tube and this serves a double purpose as it takes up the discharged pus and at the same time closes the end of the tube and seals the wound when sucked against it.

2. THE CLOSED METHOD.

Here the tube carries a shield 3 inches square or in diameter and situated two inches from its tip, and in some cases there are two shields one to/

to be inserted within the chest wall and one external to it, and a further elaboration of this tube carries on its outside, but internal to the shields, a catheter for irrigation purposes.

The procedure adopted in these cases is as follows.

As soon as the pus begins to flow through the tube the lument is clamped and the skin incision is closed carefully, after which layers of adhesive plaster are applied over the shield to keep it in situ. The pus can then be aspirated from time to time, by means of a syringe and at the same time, the cavity can be flushed with some fluid. Dakin's solution is strongly recommended. It is recommended that in these cases the attachment of another tube to the drainage tube and leading to a water-containing receptacle, tends to siphon off the pus and, at the same time assist to some extent the re-expansion of the chest.

There are disadvantages in using the closed method of drainage and the greatest of these is the liability of the exit of the pus to become impeded and often enough it becomes necessary to adopt the open method. The method of drainage is not the most important/

important question to decide. The time of choice for the operation is the factor that really matters.

ANAESTHESIA.

This very important question has already been dealt with in a previous part of this Thesis and requires no elaboration here.

AFTER-TREATMENT OF EMPYEMA.

(i) THE TREATMENT OF THE WOUND.

During the first 24 hours it will be necessary to change the dressing on at least 3 or 4 occasions, usually after that it will only require changing once in the 24 hours. The drainage tube should be kept in for a period of seven days at the least and longer if necessary. It should be noted that the tube must be shortened as the lung expands.

If there is any delay in signs of healing the formation of granulations should be stimulated by the application of silver stick. It is recommended by some that the daily exposure of the wound to the mercury vapour lamp gives a further impetus to the healing process. On the other hand it is sometimes/

sometimes found that the healing process is too precipitate, and the closure of the wound takes place before discharge has ceased, and there is a reforming of the empyema. It may be necessary to open up the wound again, on order to effect a re-establishment of the desired conditions, and one very ingenious device is the insertion of a laminaria tent for about ten hours, - this has the effect of causing a very efficient result without discomfort or distress to the patient.

ii. GENERAL TREATMENT.

When the progress has been satisfactory and there has been an absence of complications, a case of empyema should be fit to leave Hospital in from 2 to 3 weeks. Convalescent treatment in a proper home should be the next step and preference is given to the sea-side, moreover, the convalescence should not be hurried and is better supervised by physicians with special knowledge of these cases.

Climate is a matter of some importance and the place with the most sunshine and a dry atmosphere is to be recommended. In the absence of sunshine, the substitution of Ultra Violet Ray treatment is beneficial. Diet should be generous and ample with a rest after each meal. Weight should be noted and the diet altered by increase/

increase in order to improve the general condition.

GENERAL EXERCISES.

These should be carried out as soon as the patient is fit to do them and should be practised under supervision. Walking, golfing and sea bathing are excellent forms of exercise but the remedial exercises can only be done satisfactorily, under proper supervision and a proper appreciation of the requirements of the individual case. Massage at the first is very useful and properly should be the forerunner of any of the measures mentioned above.

SPECIAL EXERCISES FOR THE EXPANSION OF THE LUNG.

A good deal of diversity of opinion exists as to the advisability of encouraging the patient to indulge in breathing exercises soon after the operation. Some advise the beginning of deep breathing exercises almost as soon as the patient recovers from the shock of the operation, others are favourable to a two or three day pause, and others prefer to wait a week before the treatment is begun.

It is unwise to commence breathing exercises under three days as a general rule, and gentle whistling or gentle blowing through Woulffe's bottles should be done regularly and enthusiastically.

It/

It should be remembered that a considerable amount of deformity may remain if the attempt at lung expansion is not persisted in and this if it occurs, lies at the door of the medical attendant. Deep breathing may be further carried out, in its simplest form by the taking of a prolonged and slow inspiration, meanwhile the arms are raised from the sides to the horizontal plane. This process is repeated about ten times or more at regular intervals. In some parts where the use of exercises is very thoroughly carried out, the patient performs to music, but is not practised in this country. Encouragement should be given to the patient to indulge in expiration whilst the lower false cords are kept voluntarily closed.

If these rules are rigidly adhered to a very considerable lessening in the morbidity of empyema will be the result and there will be very little crippling from the effects of the disease.

CHRONIC DISCHARGING SINUS.

This distressing condition may sometimes be due to the neglect of the fundamental principles laid down as to treatment, at others it may be difficult/

difficult to say why it should occur. When the empyema cavity will not close and discharge continues active measures must be undertaken to deal with the sinus. There are several ways of doing this.

i. Exploration. This may be all that is necessary and there may be found at exploration a piece of necrosed rib, the removal of which allows the sinus to heal. Often enough this procedure may not be enough.

ii. Estlander's Operation. This is a serious operation. The portions of the ribs forming the outer wall of the cavity are removed subperiostially. This is effected through either multiple incisions or through one vertical incision. The fistulous track is enlarged, the pleura curetted, and the cavity washed out before a tube is inserted and the wound closed. This operation is not invariably successful.

iii. There are several modifications of the foregoing and the mention of one will suffice.

It was devised by Schede. In this operation which is more serious and more extensive than Estlander's, portions of the ribs/

ribs together with their periosteum, the intercostal tissues and the parietal pleura are removed, leaving very little except skin to cover the cavity.

- iv. Pulmonary Decortication. In this operation, and in cases favourable to its use, it is found possible to split the organised exudate covering the pleura, over the whole length of the collapsed lung, until the spongy lung tissue is exposed. This procedure is very limited in its application.

CONCLUSIONS/

C O N C L U S I O N S.

There are only one or two matters arising out of the foregoing that call for comment. Statistics are notoriously unreliable and except in isolated instances are not quoted, as they did not appear relevant to the subject matter of the Thesis, and at the same time it might appear that some of the findings in a limited investigation of this sort were at variance with those of very extensive work, and usually accepted views, and it is recognised that unless a very wide review has been undertaken, opinions as to causation and relative frequency of certain conditions are not convincing.

It does appear, however, that there is something to be said for the further investigation of intrathoracic suppuration, as to its frequency and its causation, and much more still on the subject of its treatment.

The serious mortality and morbidity of these conditions has been drawn attention to, in the course of this Thesis, and it does appear necessary that the closest co-operation between the various parties concerned is necessary, for the proper attainment/

attainment of something near the ideal in treatment.

It would seem, that there is a serious danger in the treatment of the conditions reviewed, of a conflict of interests, and the work of the physician overlaps to quite an extent, the work of the surgeon and it is difficult to know where the line of demarcation can be laid down. This seems to suggest that there should be no line of demarcation at all and that there should be close relationship between the various branches of the profession in treatment of these cases.

Further, it might be maintained that the time is nearly ripe for the devising of a scheme, whereby the treatment of these cases becomes, not a part of the general work of the Hospital as Medical and subsequently Surgical cases, but that almost from the beginning there should be a possibility of the patient becoming the care of a team, who are specially trained in the work of dealing with these serious and difficult cases, serious at all times and often difficult beyond words.

The position here is almost comparable to Neurological surgery and here the surgeon becomes a competent neurologist in the diagnosis and location/

location of the lesion.

If there is to be no proper liaison between the Physician and Surgeon in the matter of chest surgery, it will become essential that those who deal with chest diseases, will have to become competent surgeons to cope adequately with the demand which thoracic surgery is increasingly making.

It may be desirable too, but not so insistently urgent, to have as a part of the treatment proper institutions for the receipt of this class of patient who are non-tuberculous.

These two suggestions as to close team work, and the better after treatment of these cases, are worth considering by those who deal seriously with them, and are fraught with great possibilities for the amelioration of the immediate results in their treatment, and the warding off, of the sad and evil results of badly devised or badly carried out conceptions.

A.

EMBOLIC LUNG ABSCESS.

1160 AUTOPSIES.

33 EMBOLIC LUNG ABSCESSSES.

21 MALES.

12 FEMALES.

T A B L E
SHEWING NUMBER of RECORDS EXAMINED.

Number of AUTOPSIES	=	1160
Number of CASES of LOBAR PNEUMONIA	=	42
STAGE of RED HEPATISATION	=	22
STAGE of GREY HEPATISATION	=	15
STAGE of RESOLUTION	=	4
ORGANISING PNEUMONIA	=	1
ABSCCESS FORMATION	=	3

DETAILS OF EMBOLIC ABSCESSSES.

SEX	AGE	PRIMARY LESION	CHARACTER of LUNG LESION.	OTHER ABSCESSSES
F	27	Puerperal Pyaemia	Embolic Abscesses of both lungs.	Left ovary.
M	5	Osteomyelitis of lower end of Tibia	Embolic abscesses in both lungs.	Kidneys heart Testes Ileum.
M	37	Osteomyelitis of upper end of Tibia.	Pyæmic infarcts right lower lobe	
M	46	Osteomyelitis of upper end of Tibia.	Embolic abscesses both lungs.	Thyroid
M	30	Abscess of Nasal Septum	Multiple pyæmic abscesses both lungs.	Kidneys
F	54	Septic Colporrhaphy wound.	Embolic abscesses in lungs.	
M	4	Osteomyelitis of lower end of Tibia.	Embolic abscesses in both lungs.	Myocardium Kidneys Ileum
M	20	Cellulitis of lip	Embolic abscesses both lungs.	Thyroid Kidney spleen
M	5	Mastoiditis	Abscesses of right lower & middle lobe.	Skin, Hip-joint
M	16	Osteomyelitis of pubis.	Multiple abscesses in both lower lobes.	Kidneys heart hip ankle knee.

SEX	AGE	PRIMARY LESION	CHARACTER of LUNG LESION.	OTHER ABSCESSSES.
F	2½	Cellulitis of neck.	Both lungs	
F	12	Osteomyel- itis of lower end of Tibia.	Multiple abscesses both lungs.	Myocard- ium liver kidneys.
F	15	Otitis Media	Multiple abscesses both lungs	
M	54	Cellulitis of hand	Multiple abscesses both lungs	
F	32	Puerperal Pyæmia	Embolic abscess left lower lobe & right middle Lobe.	
F	35	Puerperal Pyæmia	Embolic abscess Right lower lobe	
F	32	Purulent Parametri- tis	Embolic abscesses both lungs	
F	34	Drainage of Purulent Kidney	Embolic abscess Right lung.	
M	3	Mastoiditis	Abscess cavities left lung.	
M	2	Osteomyel- itis Os calcis.	Small pyæmic ab- scesses in right lung.	
M	1½	Cellulitis of axilla	Abscesses both lungs.	
F	44	Pelvic cell- ulitis.	Embolic abscess anterior border left upper lobe	
M	33	Carbuncle of neck	Embolic abscesses both lungs	Myocard- ium.
M	9/12	Cellulitis of axilla	Multiple abscesses both lungs	

SEX	AGE	PRIMARY LESION	CHARACTER of LUNG LESION.	OTHER ABSCESSSES
M	13	Osteomyel- itis of Os Calcis	Multiple abscesses both lungs.	Myocard- ium.
M	16	Cancrum Oris	Multiple Pyaemia abscess both lungs.	Kidneys
M	3	Cellulitis of neck	Miliary abscesses Right lower lobe	
M	4	Osteomyelitis lower end of Tibia.	Miliary Haemorrhag- ic abscesses both lungs.	Kidneys liver ileum.
M	14	Otitis Media	Numerous Pyaemic abscesses and purulent infarcts both lungs.	
M	21	Appendix abscess.	Small embolic ab- cesses both lungs.	
F	31	Puerperal pyaemia	Septic infarcts rt. upper lobe.	
F	19	Pelvic abscess.	Multiple abscesses both lungs.	
M	9/12	Cellulitis of neck.	Pyaemic emboli both lungs.	

REFERENCES

1. PRICE'S Text Book of the Practice of Medicine. 1926.
 2. OSLER & M'CRAE'S Principles and Practice of Medicine 1925
 3. TIDY'S Synopsis of Medicine 1926
 4. BOYD'S Surgical Pathology 1925
 5. ROMANIS & MITCHENER'S Science and Practice of Surgery 1927
 6. CHANDLER - Diagnosis and Treatment of Bronchiectasis - The Clinical Journal, 6th July, 1927.
 7. CHANDLER - Lipiodol in Pulmonary Diagnosis, B.M.J., Feb. 5th, 1927.
 8. CHANDLER - Lipiodol Injections - British Journal of Tuberculosis, April 1927
 9. CHANDLER - The Treatment of Bronchiectasis - Lancet, May 26th 1928
 10. ROMANIS' Treatment of Empyema, B.M.J., Aug. 22nd - 1925
 11. ROMANIS' Surgery in the Treatment of Pulmonary Tuberculosis. Lancet, March 17th, 1923
 12. ROMANIS' Treatment of Empyema and Acute Abscess of the Lung. Practitioner 1924.
-